Structural Tuning of Two-Dimensional Perovskites at High Pressure

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Western

Introduction

- Characterize 2D-Perovskites: $DPDAPbI_4$ and $CMAPbI_4$ at high pressure
- Many opto-electronic applications such as solar cells
- Objective is to observe irreversible changes to optimize efficiency in its application

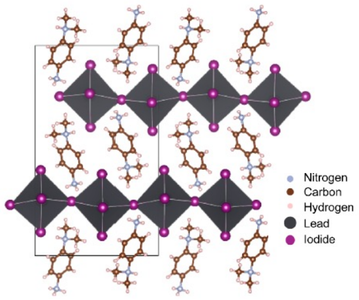


Illustration of $DPDAPbI_4$ crystal structure

CMA_2PbI_4 lattice structure similar to that of $DPDAPbI_4$ with CMA as the organic spacer

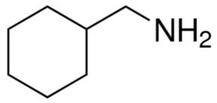
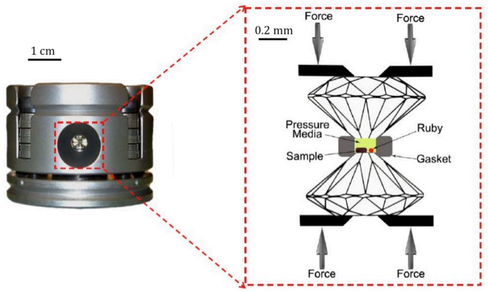


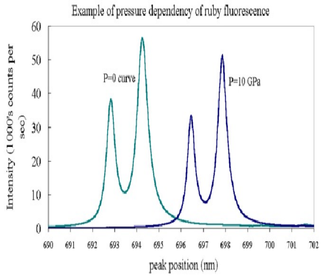
Photo of Cyclohexane Methyl Amine (CMA)

Experimental



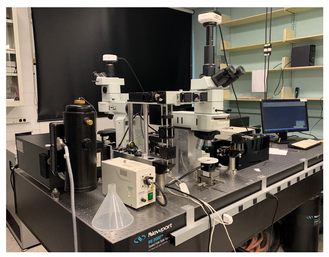
Diamond Anvil Cell (DAC)

- Used to apply static pressure to the sample



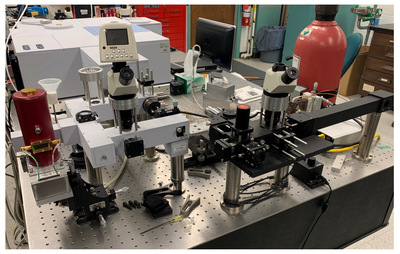
Ruby fluorescence

- Used to determine the pressure of the sample inside of DAC



Raman Spectroscopy

- Measures vibrational frequencies based on the inelastic scattering of light from the sample

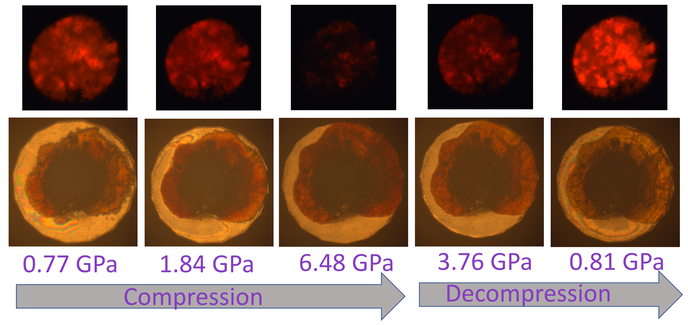


Fourier-Transform Infrared Spectroscopy (FTIR)

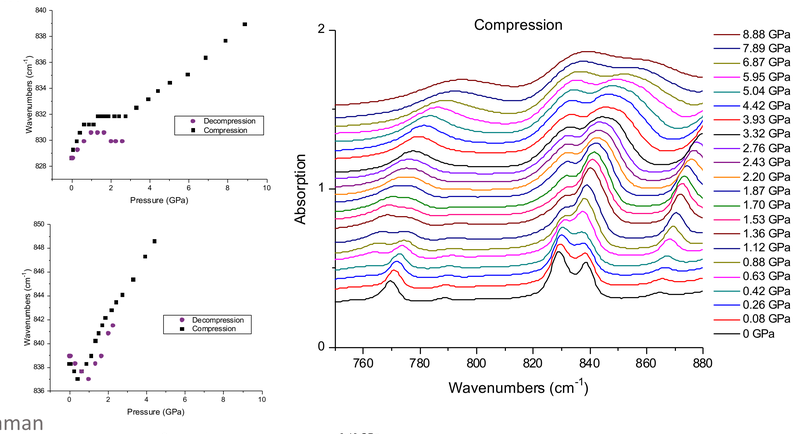
- Measures the frequencies at which a sample absorbs IR radiation corresponding to vibrations

Results

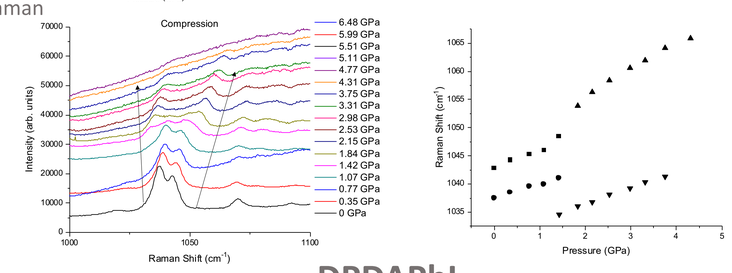
CMA_2PbI_4



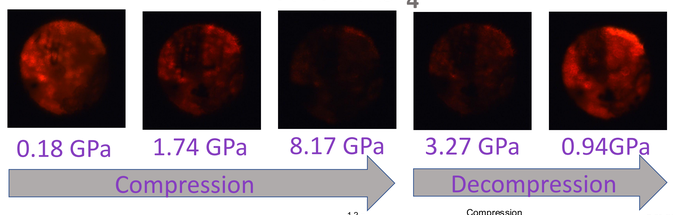
FTIR



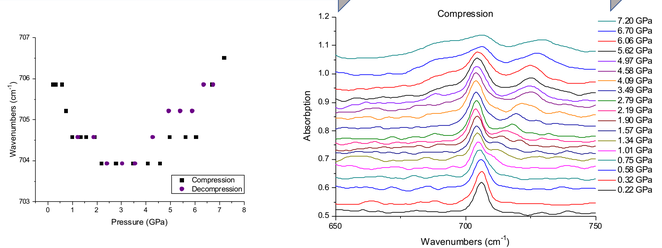
Raman

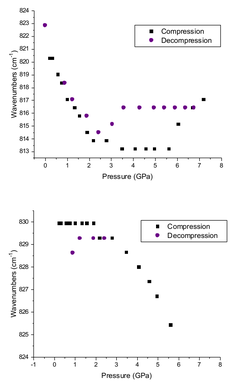


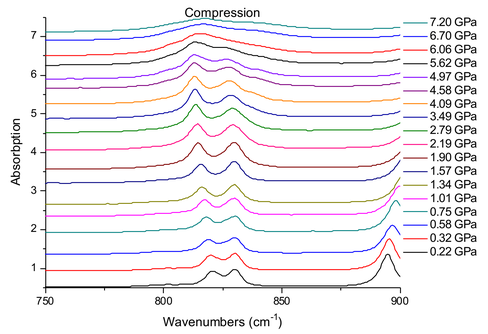
$DPDAPbI_4$



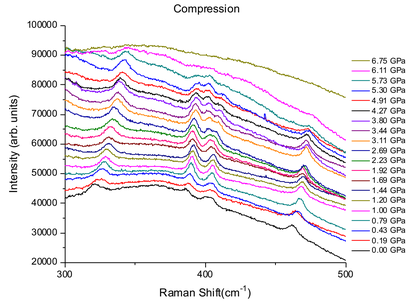
FTIR







Raman



Conclusions

- Both materials underwent a reversible amorphization
- Metastable change did not occur
- Potential phase change at ~2 GPa and ~5 GPa for $DPDAPbI_4$ and at ~0.5 GPa, ~1.5GPa, and ~3 GPa for CMA_2PbI_4
- Further research to determine band gap energy, photoluminescent properties, and confirm suspected phase changes

References

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Acknowledgements

- Funding: UWO, USRI, NSERC
- Supervision: Jesse Ratte, Prof. Song